EXPLORING THE POTENTIAL FOR TECHNOLOGY-BASED NUTRITION EDUCATION FOR LOW-INCOME FAMILIES IN ALASKA

By

Julianne M Power, B.A.

A Thesis Submitted in Partial Fulfillment of the Requirements

for the Degree of

Master of Science

in

Health Promotion: Interdisciplinary Studies

University of Alaska Fairbanks

August 2016

APPROVED:

Andrea Bersamin, Committee Chair
Jennifer Johnson, Committee Member
Kathryn Braun, Committee Member
Kris Hundertmark, Chair
Department of Biology and Wildlife
Paul Layer, Dean
College of Natural Science and Mathematics
Michael Castellini, *Dean of the Graduate School*

Abstract

This thesis addresses the need to identify more accessible and cost-effective ways for federal food assistance programs to deliver nutrition education to Alaska Native people living in rural and remote communities in Alaska. The ultimate aim is to explore whether technology-based nutrition education is a feasible and acceptable alternative to traditional face-to-face nutrition counseling. I begin this thesis by examining the preliminary efficacy and acceptability of an 11 week text message-based intervention to promote fruit and vegetable (F&V) intake among parents with young children (n=74) using a pre-post study design. Although there were no changes in pre-post measures, most participants reported positive changes in attitudes and behaviors related to F&V intake since participating in the intervention. Participants thought the intervention was credible (80.8%), found texts useful (71.6%), and would recommend the program to a friend (82.2%).The next chapter explores the feasibility of technology-based nutrition education in rural and remote areas of the state by estimating the use of media technology among Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) participants (n=975) in Alaska Native communities using a self-administered, mailed questionnaire. The response rate was 37.7% (N=368). Respondents were primarily Alaska Native (99.1%) women (97.5%) between 18-29 years of age (56.6%). Smartphone (78.8%) and Facebook (80.3%) use were comparable to national averages, but having a computer at home (38.4%) was much less likely. Text messaging was common, with 93.3% of respondents reporting use at least once per week or more frequently. Potential barriers included slow internet (51.0%), no computer access (42.1%), and high cost of internet (35.1%). Nutrition education delivered via mobile devices is an ideal way to reach Alaska Native people in remote communities, provided that such programs limit the amount of cellular data necessary for participation. The findings from this thesis provide important evidence supporting the use of text messaging and other media technology in nutrition education efforts by WIC and other federal food assistance programs for Alaska Native people living in rural and remote communities. These findings will inform technology-based nutrition education efforts throughout Alaska.

Table of Contents

Page

List of Figures

Page

List of Tables

Page

List of Appendices

Page

Acknowledgements

First, I would like to acknowledge all of the study participants that made this research possible. I would like to thank the Fairbanks Families Partnership, ThrivAlaska Head Start, the WIC offices in Fairbanks and Bethel, the State of Alaska Family Nutrition Program, and the Yukon-Kuskokwim Health Corporation for their support of this project and for the opportunity to work with the community to conduct this research.

Next, I would like to thank Dr. Andrea Bersamin, without whom none of this would be possible. Andrea's positive guidance has helped shape me into the person I am today. Her unwavering trust and support has inspired me to continue my studies and pursue a PhD in public health. Andrea, I deeply admire you both professionally and personally. I hope I can be half the mentor that you are someday. I would also like to thank my committee members, Jennifer Johnson and Dr. Kathryn Braun, for their dedication to and enthusiasm for this project. Thank you for your positivity and confidence in me.

I would like to thank the Children's Healthy Living Program, which helped fund this research and gave me invaluable insight and experience that contributed immensely to this work. I would also like to thank all of the faculty and staff at the Center for Alaska Native Health Research, who made it such a pleasure to come to work every day. I owe a huge thank you to Holly Hansell, Lindy Larson, Daniel Uliassi, Jacques Philip, and Courtney Braccio, for all of the time and effort that they contributed to this project.

Finally, thank you to all of my family and friends who made my time in Alaska so completely extraordinary. To my Mom and Dad, whose unconditional love and support kept me going throughout this journey. To Suz, my first friend in Fairbanks, who became my family away from home. To Olivia and Jordan, who have always been there for me. To Torv, who can always put a smile on my face and brighten my day. To Doug and Carla, who I can count on for anything and everything. I love you all, and I will miss you dearly. Thank you for everything.

.

Chapter 1: Introduction

This thesis addresses the need to identify more accessible and cost-effective ways for federal food assistance programs to deliver nutrition education to Alaska Native people living in rural and remote communities in Alaska. Nutrition education plays an important role in reducing health disparities by encouraging preventive health behaviors, such as a nutritious diet, and has been associated with dietary improvements[1-4]. Programs to improve diet are typically delivered through worksite or school-based programs, individual or group counseling, or large-scale campaigns to increase knowledge and awareness[4]. These approaches generally result in modest or no change in dietary behaviors; however, higher-intensity programs have been shown to achieve greater effects[4-6]. High-intensity programs are costly and resource-intensive, generally requiring multiple in-person contacts with nutrition professionals, an approach that is not sustainable in a public health setting. Federally funded food assistance programs, such as the Supplemental Nutrition Assistance Program (SNAP) and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) that provide nutrition education on a national scale, have prioritized moving toward more evidence-based public health approaches that are effective at the population level[7].

1.1 The WIC Program Works

Nutrition education is a much larger component of the WIC program than of the SNAP program[8]. Unlike the SNAP program, the WIC program is required to provide individual nutrition education contacts for all participants at least once every three months. Additionally, although both programs provide food vouchers, the SNAP program does not restrict food purchases while the WIC program provides vouchers for specific nutrient-dense foods that address dietary deficits in the target populations. The WIC program serves low-income pregnant, breastfeeding, and non-breastfeeding postpartum women, infants and children up to five years old. Almost half of all infants in the U.S. participate in WIC, and the program accounts for about 10% of all federal spending on food and nutrition assistance[9]. The WIC program has been shown to be effective, improving birth outcomes by lowering infant mortality rates,

decreasing preterm birth rates, and increasing birth weight[10,11]. Additionally, participation in WIC has been shown to lower the prevalence of anemia[12] and improve nutrient intake[13] in infants and children, and to positively impact total diet quality at the household level[8]. Although some studies indicate that the protective effects of WIC on factors such as preterm birth and fetal growth are overestimated, policymakers have concluded that WIC works[14,15].

1.2 Effectiveness of WIC Nutrition Education

Although the WIC program has been associated with positive effects, the direct impact that WIC nutrition education has on participants is unclear as it is rarely evaluated separately from the entire program[9]. Additionally, variations in how WIC nutrition education is implemented between and within states make evaluation difficult[9]. The long-term effect that WIC nutrition education has on dietary behaviors is unknown, and evidence supporting short-term behavior change is limited[16]. There is mixed evidence to show that WIC nutrition education can improve nutrition knowledge and other outcome measures; while some studies show improvements[16,17], others show no change[18,19]. One explanation is that WIC participants already have high levels of nutrition knowledge before their first nutrition education contact[16,18]. Hence, WIC educators may be spending limited time and resources providing WIC participants with general nutrition information that they already know. A more personalized approach could improve participant engagement, as nutrition education is most effective when tailored to the specific dietary needs and behaviors of the target participants[20]. However, low participant follow-up significantly hinders the effective delivery of nutrition education services[16]. Since WIC participants are not required to attend nutrition education contacts, they are usually scheduled during certification and voucher issuance to increase attendance. During these short sessions, nutrition educators are often time-constrained, conducting and processing certification information in addition to counseling. Although the majority of WIC participants have the opportunity to receive both nutrition education contacts, attendance at the second contact is typically low[16]. A nutrition education approach that increases participant follow-up could expand the reach of such services. Because nutrition education is a mandatory component of the WIC program, more rigorous evaluations should be conducted to explore its impact and to identify ways

to maximize its effectiveness[15]. Additionally, more programmatic flexibility among WIC agencies would facilitate new and innovative approaches to improve WIC nutrition education[15].

1.3 WIC Nutrition Education and Alaska Native People

It is unclear whether and to what extent WIC nutrition education improves behavioral health outcomes among Alaska Native people and other indigenous populations. A large proportion of WIC participants, about 11.1%, identify as American Indian or Alaska Native, compared to less than 1% of the general U.S. population[21]. However, nutrition education materials are rarely tailored for American Indian and Alaska Native people[22], although they experience significant nutrition-related health disparities and have the highest prevalence of diabetes and obesity compared to any other ethnic group in the U.S.[23]. Low fruit and vegetable intake among Alaska Native people contributes to the occurrence of chronic disease. In some parts of Alaska, more than 90% of Alaska Native adults consume less than the recommended daily servings of fruits and vegetables[22]. Residents of rural areas of the state are even less likely to meet fruit and vegetable intake recommendations and to report having received diet advice in the past year[22]. Nutrition education that is tailored for Alaska Native people, especially those living in rural areas, should be a priority because of the significant health disparities experienced by this population.

The State of Alaska WIC program faces significant challenges to delivering nutrition education to remote and rural Alaska Native communities, which are only accessible by plane year round or by boat in the summer. Low population density (less than one person per square mile) and lack of affordable travel between these communities makes delivering in-person nutrition education, traditionally used by the WIC program, prohibitively expensive[22]. More cost-effective methods are needed to effectively deliver WIC nutrition education to Alaska Native people living in rural and remote areas.

1.4 Potential for Electronic Health in WIC Nutrition Education

One way to address the challenges that WIC faces in Alaska is to deliver nutrition education remotely, via media technology. Media technology, such as the Internet, cell phones, and computers provide new avenues to relay health information and to promote health and well-being. One benefit of a technology-based approach to nutrition education is that technology use is widespread; 84% of American

adults used the Internet in 2015 and 90% of American adults owned a cell phone in 2014[24,25]. Using a ubiquitous form of technology, such as text messaging via cell phones, to distribute health information may be more cost-effective than face-to-face counseling on a larger scale[26,27]. Another benefit is that a technology-based approach may improve the reach of nutrition education, especially in low-resource areas where technology use is spreading faster than the growth of older infrastructure, such as roads[26,28]. Finally, technology can improve the quality of health care by providing information that is tailored to the knowledge, education, language, and other preferences of specific users, and deliver that information instantaneously via the Internet[26,29]. Compared to traditional face-to-face counseling, technology-based nutrition education could reduce health service costs for the WIC program, reach a greater proportion of underserved populations in low-resource areas, and allow for low-cost personalization of nutrition education materials[30].

This thesis builds on previous work showing that web- and computer-delivered, as well as text message-based, interventions can improve knowledge and behavioral health outcomes, such as physical activity, nutrition, tobacco use, and safe sexual behavior[31-37]. Previous studies with WIC populations have shown that Internet-based interventions can increase fruit and vegetable consumption and positively impact movement along stages of change associated with parent-child feeding behaviors[36,37]. The ultimate goal of this research was to explore whether technology-based nutrition education is a feasible and acceptable alternative to traditional face-to-face approaches in Alaska. I began this research by developing and evaluating a text message-based intervention to promote fruit and vegetable consumption among parents with young children in Fairbanks, Alaska (Chapter 2). The objective of this research was to examine the preliminary efficacy and acceptability of the text message-based intervention using a pre-post study design in a more urban and accessible population in Alaska.

Chapter 3 focuses on the assessment of media technology use and related activities in rural and remote Alaska Native communities in the Yukon-Kuskokwim (YK) River Delta in southwestern Alaska. A needs assessment conducted by the State of Alaska SNAP Education program emphasized the need for tailored nutrition education materials in this region[22]. The objective of this research was to gauge the

potential for and interest in technology-based nutrition education programs by surveying a representative sample of WIC authorized representatives in the region.

The feasibility and acceptability of technology-based nutrition education has never been explored in Alaska before. A statewide framework to deliver technology-based nutrition education exists through the WIC program. Hence, partnering with WIC and the State of Alaska Family Nutrition Program was an ideal way to ensure that this research would be both applicable and sustainable for the target population. The results of this thesis lend insight into convenient and cost-effective ways to effectively deliver nutrition education to remote and rural populations and will guide technology-based nutrition education efforts in Alaska.

1.5 References

1. Havas S, Anliker J, Damron D, Langenberg P, Ballesteros M, Feldman R. Final Results of the Maryland WIC 5-A-Day Promotion Program. *Am J Public Health*. 1998;88(8):1161-67.
2. Havas S, Anliker J, Greenberg D, Block G, Block T, Blik C, Langenberg P, DiClemente C. Final results of the Maryland WIC food for life program. *Prev Med*. 2003;37(5):406-16.
3. Anderson JV, Bybee D, Brown RM, McLean DF, Garcia EM, Breer ML, Schillo BA. 5 A Day Fruit and Vegetable Intervention Improves Consumption in a Low Income Population. *J Am Diet Assoc*. 2001;101(2):195-202.
4. Pomerleau J, Lock K, Knai C, McKee M. Effectiveness of interventions and programmes promoting fruit and vegetable intake. European Centre on Health of Societies in Transition, London School of Hygiene and Tropical Medicine, United Kingdom. 2005.
5. Ciliska D, Miles E, O'Brien MA, Turl C, Tomasik HH, Donovan U, Beyers J. Effectiveness of Community-Based Interventions to Increase Fruit and Vegetable Consumption. *J Nutr Educ Behav*. 2000;32(6):341-352.
6. Pignone MP, Ammerman A, Fernandez L, Orleans CT, Pender N, Woolf S, Lohr KN, Sutton S. Counseling to promote a healthy diet in adults: a summary of the evidence for the U.S. Preventive Services Task Force. *Am J Prev Med*. 2003;24(1):75-92.

7. United States Department of Agriculture Food and Nutrition Service and the National Collaborative on Childhood Obesity Research. SNAP-Ed Strategies and Interventions: An Obesity Prevention Toolkit for States; Evidence-based Policy and Environmental Change in Child Care, School, Community, and Family Settings. July, 2013. https://snaped.fns.usda.gov/snap/SNAP-EdInterventionsToolkit.pdf. Accessed November 16, 2015.
8. Basiotis P, Kramer-LeBlanc C, Kennedy E. Maintaining Nutrition Security and Diet Quality: the Role of the Food Stamp Program and WIC. *Fam Econ Rev*. 1998;11:4-16.
9. Oliveira V, Frazao E. The WIC Program: Background, Trends, and Economic Issues, 2009 Edition. US Department of Agriculture, Economic Research Service, Economic Research Report No. 73. April 2009.
10. Khanani I, Elam J, Hearn R, Jones C, Maseru N. The Impact of Prenatal WIC Participation on Infant Mortality and Racial Disparities. *Am J Public Health*. 2010;100(S1):S204-09.
11. Kowaleski-Jones L, Duncan GJ. Effects of Participation in the WIC Program on Birthweight: Evidence from the National Longitudinal Survey of Youth. *Am J Public Health*. 2002;92(5):799-804.
12. Sherry B, Mei Z, Yip R. Continuation of the decline in prevalence of anemia in low-income infants and children in five states. *Pediatrics*. 2001;107(4):677-82.
13. Rose D, Habicht JP, Devaney B. 1998. Household Participation in the Food Stamp and WIC Programs Increases the Nutrient Intakes of Preschool Children. *J Nutr*. 1998;128(3):548-55.
14. Joyce T, Racine A, Yunzal-Butler C. Reassessing the WIC Effect: Evidence from the Pregnancy Nutrition Surveillance System. *J Pol Anal Manag*. 2008;27(2):277-303.
15. Besharov DJ, Germanis P. Rethinking WIC: An Evaluation of the Women, Infants, and Children Program. The American Enterprise Institute (AEI) Press. 2001.
16. Fox MK, Burstein N, Golay J, Price C. WIC Nutrition Education Assessment Study: Final Report. U.S. Department of Agriculture, Food and Nutrition Service, Office of Analysis, Nutrition and Evaluation. Alexandria, VA: 1999.

17. Ritchie LD, Whaley SE, Spector P, Gomez J, Crawford PB. Favorable Impact of Nutrition Education on California WIC Families. *J Nutr Educ Behav*. 2010;42.

18. Randall B, Sprague K, Connell DB, Golay J. WIC Nutrition Education Demonstration Study: Final Report Prenatal Intervention. U.S. Department of Agriculture, Food and Nutrition Service, Office of Analysis, Nutrition and Evaluation. Alexandria, VA: 2001.

19. Bell L, Gleason S. Using Point-of-Purchase Data To Evaluate Local WIC Nutrition Education Interventions: Feasibility Study. U.S. Department of Agriculture, Economic Research Service, Contractor and Cooperator Report No. 26. January 2007.

20. Campbell MK, DeVellis BM, Strecher VJ, Ammerman AS, DeVellis RF, Sandler, RS. Improving Dietary Behavior: The Effectiveness of Tailored Messages in Primary Care Settings. *Am J Public Health*. 1994;84(5): 783-787.

21. United States Department of Agriculture Food and Nutrition Service Office of Policy Support. WIC Participant and Program Characteristics 2014 Final Report. November 2015. http://www.fns.usda.gov/sites/default/files/ops/WICPC2014.pdf. Accessed June 8, 2016.

22. State of Alaska Department of Health and Social Services, State of Alaska Family Nutrition Program, and University of Alaska Fairbanks. Alaska SNAP-Ed Needs Assessment. 2014. http://dhss.alaska.gov/dpa/Documents/dpa/pdf/Alaska_SNAP_needs_assessment_report pdf. Accessed November 16, 2015.

23. Jernigan VB, Duran B, Ahn D, Winkleby M. Changing patterns in health behaviors and risk factors related to cardiovascular disease among American Indians and Alaska Natives. *Am J Public Health*. 2010 Apr;100(4):677-83.

24. Perrin A, Duggan M. Americans' Internet Access: 2000-2015. Pew Research Center. 2015. http://www.pewinternet.org/2015/06/26/americans-internet-access-2000-2015/. Accessed September 29, 2015.

25. Mobile Technology Fact Sheet. Pew Research Center. 2014. http://www.pewinternet.org/fact-sheets/mobile-technology-fact-sheet/. Accessed September 29, 2015.

26. Eysenbach G. What is e-health? *J Med Internet Res.* 2001;3(2):e20.

27. Tate EB, Spruijt-Metz D, Dunton GF. mHealth approaches to child obesity prevention: successes, unique challenges, and next directions. *Transl Behav Med.* 2013;3(4):406-15.

28. Qiang CZ, Yamamichi M, Hausman V, Miller R, Altman D. Mobile Applications for the Health Sector. *ICT Sector Unit World Bank.* 2012.

29. Henriquez-Camacho C, Losa J, Miranda JJ, Cheyne NE. Addressing healthy aging populations in developing countries: unlocking the opportunity of eHealth and mHealth. *Emerg Themes Epidemiol.* 2014;11:136.

30. Brug J, Oenema A, Campbell M. Past, present, and future of computer-tailored nutrition education. *Am J Clin Nutr.* 2003;77(suppl):1028S-34S.

31. Portnoy DB, Scott-Sheldon L, Johnson BT, Carey MP. Computer-delivered interventions for health promotion and behavioral risk reduction: A meta-analysis of 75 randomized controlled trials, 1988-2007. *Prev Med.* 2008;47:3-16.

32. Norman GJ, Zabinski MF, Adams MA, Rosenberg DE, Yaroch AL, Atienza AA. A Review of eHealth Interventions for Physical Activity and Dietary Behavior Change. *Am J Prev Med.* 2007;33(4):336-345.

33. Broekhuizen K, Kroeze W, van Poppel M, Oeneme A, Brug J. A Systematic Review of Randomized Controlled Trials on the Effectiveness of Computer-Tailored Physical Activity and Dietary Behavior Promotion Programs: an Update. *Ann Behav Med.* 2012;44:259-286.

34. Wantland DJ, Portillo CJ, Holzemer WL, Slaughter R, McGhee EM. The Effectiveness of Web-Based vs. Non-Web-Based Interventions: A Meta-Analysis of Behavioral Change Outcomes. *J Med Internet Res.* 2004;6(4):e40.

35. Fjeldsoe BS, Marshall AL, Miller YD. Behavior change interventions delivered by mobile telephone short-message service. *Am J Prev Med.* 2009;36(2):165-173.

36. Bensley RJ, Anderson JV, Brusk JJ, Mercer N, Rivas J. Impact of Internet vs Traditional Special Supplemental Nutrition Program for Women, Infants, and Children Nutrition Education on Fruit and Vegetable Intake. *J Am Diet Assoc*. 2010;11:1723-1727.

37. Bensley RJ, Brusk JJ, Anderson JV, Mercer N, Rivas J, Broadbent LN. wichealth.org: Impact of a Stages of Change-Based Internet Nutrition Education Program. *J Nutr Educ Behav*. 2006;38(4):222-229.

Chapter 2: Txt4HappyKids: A Text Messaging Pilot Study to Promote Fruit and Vegetable Intake Among Families with Young Children[1]

2.1 Abstract

Objective: Examine preliminary efficacy and acceptability of a text message-based intervention to promote fruit and vegetable (F&V) intake among families with young children.

Design: Pre-post study design.

Setting: Fairbanks, Alaska.

Participants: Parents (n=74) of young children were recruited from community venues.

Intervention: An 11 week, theory-based intervention to promote child F&V intake. Parents received two texts per week that addressed personal, behavioral, and environmental barriers to F&V intake.

Main Outcome Measures: Behaviors, behavioral intent, self-efficacy, attitudes, and perceived barriers to F&V intake. Perceived changes in attitudes and behaviors, and qualitative feedback, were collected post-intervention.

Analysis: Data were analyzed using descriptive statistics and a Wilcoxon signed-rank test to examine changes in outcome measures pre-post intervention.

Results: No changes in pre-post measures were observed. However, most participants reported positive changes in attitudes and behaviors since participating in Txt4HappyKids. Participants thought Txt4HappyKids was credible (80.8%), found texts useful (71.6%), and would recommend the program to a friend (82.2%).

Conclusion and Implications: Parents felt positively impacted and reported high satisfaction with Txt4HappyKids. Despite absence of face-to-face contact, parents were engaged and receptive to nutrition information. High acceptability shows promise for adoption of this low-cost intervention by budget-constrained nutrition programs.

[1] Power JM, Bersamin A. Txt4HappyKids: A text messaging pilot study to promote fruit and vegetable intake among families with young children. Submitted to the Journal of Nutrition Education and Behavior. 2016.

2.2 Introduction

Increasing fruit and vegetable (F&V) intake among low-income populations, especially children, is a priority for federal food assistance programs such as the Supplemental Nutrition Assistance Program (SNAP) and the Women, Infants, and Children Program (WIC). Most interventions to increase F&V intake among children involve face-to-face delivery methods, either through primary care, home visiting, or school-based programs[1]. Although this strategy has resulted in small, significant increases in F&V consumption, person-to-person contact can be challenging in terms of cost and time. With over 46 million SNAP and 8 million WIC participants in January 2015, cost-effective and efficient methods are needed to effectively deliver nutrition education to such large populations[2].

Texting is an ideal, cost-effective tool to promote health behaviors among hard-to-reach populations for a number of reasons. First, the technology is ubiquitous. More than 90% of adults in the United States own a cell phone and more than 80% of cell phone owners report sending or receiving text messages on their phone[3,4]. Americans send and receive 6.3 billion texts per day[5]. Cell phone ownership is prevalent across income groups, and approximately 85% of adults with an annual income below $30K owned a cell phone during 2014[4]. Second, text messaging is personal, and texts are important to recipients; 67% of cell phone owners check their phones for calls or messages, even when their phone did not ring or vibrate[5]. Approximately 90% of text messages are read within three minutes, and over 99% of all texts are read by the recipient[6]. Finally, text messaging is a cost-effective way to distribute health information on a large scale, reducing health service costs and participant burden[7].

Federal food assistance programs, such as SNAP and WIC, are shifting toward multilevel community-based and public health approaches for obesity prevention[8]. A growing number of federal food assistance programs are incorporating text messaging into their programming. The University of Maryland Extension has partnered with SNAP Education to create Text2BHealthy, a program that promotes nutrition and physical activity by linking school-based nutrition education to healthy behaviors at home[9]. Text4Baby has partnered with WIC to reinforce nutrition education for pregnant women through text messages[10]. Although results from these programs have not yet been published, previous

studies have demonstrated that text messaging can effectively promote diabetes and weight management, medication compliance, smoking cessation, and other health behaviors[11-18]. While most of these studies have examined the use of text messaging to enhance treatment outcomes in a clinical setting, less information is available on how text messaging can be used for preventive behaviors, such as consuming F&V[19-21].

A text messaging intervention to promote F&V intake may be a convenient and cost-effective way for parents to receive health-related information about their children. This paper reports on the preliminary efficacy and acceptability of a text messaging intervention to promote F&V consumption among parents of young children from low-income families in Fairbanks, Alaska. Alaska is an ideal place to pilot test this program because insufficient F&V intake is a common dietary shortcoming resulting from unique environmental factors. Additionally, low population density across the state and lack of affordable travel between communities significantly limits traditional, face-to-face nutrition education. Hence, an efficient and cost-effective approach to nutrition education is needed[22].

2.3 Methods

2.3.1 Study Design

Txt4HappyKids is an 11-week intervention that sends parents text messages promoting child F&V consumption twice weekly. The intervention was evaluated using a pre-post study design. Parents completed a self-administered questionnaire to assess behaviors, behavioral intent, self-efficacy, attitudes, and perceived barriers related to F&V intake at baseline and post-intervention.

Participants (n = 107) were recruited using purposive sampling at Head Start (n = 18); WIC (n = 18); the public library (n = 12); and a free family health fair (n = 59) in Fairbanks, Alaska. Fairbanks is the second largest city in Alaska with a population of approximately 30,000 people. Inclusion criteria were being the parent or guardian of a young child (no age specified) and having an unlimited texting plan on a mobile phone. All procedures were approved by the University of Alaska Fairbanks Institutional Review Board for human subjects.

2.3.2 Intervention

Text message development was guided by the Social Cognitive Theory (SCT) and messages were designed to address personal, behavioral, and environmental factors related to F&V intake[23] (Table 2.1). Personal factors, such as limited time during the day to shop for and prepare F&V, were addressed through messages that portrayed shopping and cooking with children as important family time (e.g., "Kids love to be helpful! Let them help with dinner by washing the fruits & veggies, stirring, or measuring. This is a great way to spend quality time together!). Behavioral factors, such as lack of knowledge and skills related to preparing F&V were addressed through messages that shared recipes and other preparation tips (e.g., Frozen broccoli has as much fiber as fresh broccoli! Microwave until tender & toss with some olive oil, lemon juice, garlic powder, salt & pepper!). Environmental factors, such as high cost of produce, were addressed through messages announcing sales on produce items at local grocery stores (e.g., "Satsuma Mandarins are on sale @ Fred Meyer for $5.99/5 lb box! Keep your kids on the fast track to health with this sweet snack that is quick & easy to eat."). Messages were limited to 160 characters and content was inspired by the TXT4Tots library of evidence-based messages created by the U.S. Department of Health and Human Services and the American Academy of Pediatrics[24]. The research team developed 61 text messages that were pilot tested with 15 low-income women through individual or group interviews. These women were asked to rate the messages from least to most useful. Messages were then revised and selected for use in the Txt4HappyKids intervention.

2.3.3 Instrument

The baseline questionnaire was administered in-person and the post-intervention survey was administered electronically via SurveyMonkey™. Survey questions were adapted from the Food Stamp Program Fruit and Vegetable Checklist[25] and the Fruit and Vegetable Inventory[26].

2.3.4 Variables Measured

Behavior was measured using a single scale consisting of four items related to serving F&V to children: how often (a) participants serve meals with F&V, (b) their child eats F&V as a snack, (c) their child eats more than one kind of vegetable a day, (d) their child eats more than one kind of fruit a day.

Response options ranged from 1 (rarely) to 5 (always), and therefore higher scores represented more frequent behaviors that involve serving F&V to children ($\alpha = 0.84$).

Behavioral Intent was measured using a single scale consisting of two items related to progress toward the goal of serving children 1 cup of fruit and 1 heaping cup of vegetables each day. Response options ranged from 1 (I am not thinking about serving my child more F&V) to 5 (I am already serving my child 1 or more cups of F&V a day), and therefore higher scores represented greater behavioral intent to follow daily recommendations for child F&V intake ($\alpha = 0.79$).

Self-Efficacy was measured using a single scale consisting of six items related to shopping for and serving F&V to children. Participants were asked how strongly they agreed with the statements: I feel that I can (a) serve more F&V as a snack, (b) buy more vegetables next time I shop, (c) serve meals or snacks with more fruit during the next week, (d) serve two or more servings of vegetables at dinner, (e) serve meals with more vegetables during the next week, and (f) add extra vegetables to casseroles and stews. Response options ranged from 1 (strongly disagree) to 5 (strongly agree), and therefore higher scores represented greater self-efficacy related to buying and serving children more F&V ($\alpha = 0.87$).

Attitudes were measured using a single scale consisting of five items related to perceived benefits of serving F&V to children and role modeling F&V intake. Participants rated their agreement with the statement: I feel that (a) I am helping my child's body by serving them more F&V, (b) my child may develop health problems if they do not eat F&V, (c) eating F&V will help my child succeed in school, (d) I might be able to influence my child to be healthier by eating F&V more often, and (e) I would set a good example for my child if I ate more F&V. Response options ranged from 1 (strongly disagree) to 5 (strongly agree), and therefore higher scores represented more favorable attitudes toward serving F&V and being a role model for F&V intake ($\alpha = 0.87$).

Perceived barriers of F&V intake were measured using a single scale consisting of seven items. Participants were asked to rate their agreement with the statement: Increasing the amount of F&V I eat means choosing foods that (a) are inexpensive, (b) my child likes, (c) are easy to prepare, (d) are easy to find, (e) are filling, (f) taste good, and (g) protect my child's health. Response options ranged from 1

(strongly disagree) to 5 (strongly agree). Therefore, higher scores represented fewer perceived barriers to eating more F&V ($\alpha = 0.77$).

In addition to these measures, at post-intervention participants answered questions related to perceived changes in attitudes and behaviors related to F&V intake since participating in the intervention. Participants also answered questions related to intervention satisfaction. Finally, participants answered open-ended questions, including "What did you like most about Txt4HappyKids?", and "What changes would make Txt4HappyKids better?".

2.3.5 Analysis

Frequencies were calculated using IBM SPSS Statistics 19 Software[27] to examine participant demographics and general response patterns. A Wilcoxon signed-rank test was used to compare paired pre- and post-intervention responses to the questionnaire. Open-ended questions were coded for concepts and themes by two separate coders using the constant comparative method of analysis in Microsoft Excel[28]. Coders discussed disagreements in coding until a consensus was reached. Only participants who completed both the baseline and post-intervention questionnaire were included in the final analysis.

2.4 Results

2.4.1 Participant Characteristics

Seventy-four participants (69%) completed both the baseline and post-intervention questionnaire. Demographic characteristics are presented in Table 2.2. The majority of participants were White females between 25-34 years old with some college education and a child under 5 years old. Almost half reported receiving food assistance in the last 12 months from WIC; SNAP; emergency food banks, food pantries, soup kitchens; and/or meals served at a food kitchen or community site.

2.4.2 Preliminary Efficacy

Estimates of behavior, behavioral intent, self-efficacy, attitudes, and perceived barriers related to F&V intake were positive at baseline. A Wilcoxon signed-rank test showed that there were no significant changes in participant responses to these measures post-intervention (Table 2.3). However, most participants reported that since participating in Txt4HappyKids, they served their child more F&V

because they thought they were beneficial (92%), tried to follow a healthier diet (87%), tried different ways of preparing F&V (85%), and were more aware of the foods their child eats (81%). Additionally, most participants agreed or strongly agreed that more fruits (84%) and vegetables (78%) are available in their home since participating in the intervention.

2.4.3 Program Acceptability

Overall, participants liked the intervention. Most participants thought Txt4HappyKids was very credible (81%) and found the text messages very useful (72%). More than half of participants reported wanting to receive more texts about eating F&V (68%), and most would recommend the program to a friend (82%). Three-quarters of participants felt they received the right amount of messages (76%), and no one reported that they received too many messages.

2.4.4 Qualitative Feedback from Participants

Participants were largely positive regarding their experience with the intervention. Sales announcements and recipes were particularly helpful and participants mentioned that sales announcements "helped me plan what to buy" and that recipes "helped me help my son explore new foods." They noted that the intervention "wasn't just 'you should do this or that.' It was actually ideas," and that "I wouldn't have thought about it [the ideas] without the text." A perceived benefit of the program was that it was "convenient, consistent and free" and "easy, short and to the point." Many participants noted that texts served as reminders, stating "I think one of the most helpful things is that it puts the idea in your mind and you think about it through the day" and "I also liked the reminder that if I eat better, my kids will see that as an example. It's easy to forget that at times." Others mentioned that the program was "great encouragement for those who are trying to feed their kids healthier foods and a great reminder for those parents already feeding their kids healthy."

When asked what changes would improve the program, many participants expressed wanting to receive texts more frequently, such as every other day, every time there was a sale on produce, or for more than 11 weeks. Others reported wanting an interactive element. Regarding message content, participants wanted more recipes, sales, and links to websites or articles with additional information.

Many noted that more tips about how to address picky eating would be helpful, stating "I would have liked ideas on how to get a picky eater to eat more of variety," and "I need help convincing the kids that fruits and veggies aren't gross."

2.5 Discussion

This pilot study examined the preliminary efficacy and acceptability of a text messaging intervention to promote F&V intake among families with young children. Our key finding was that the majority of parents felt positively impacted by the intervention and reported high satisfaction. This is important because parents were engaged and receptive to the nutrition information received, despite the absence of face-to-face interaction, which is costly and resource intensive. Engagement is a key component of intervention efficacy. A recent study by Pedersen et al. showed greater improvements in intervention effects with higher participant engagement in a text message-based feedback intervention to increase F&V intake among adolescents[20]. High levels of engagement and acceptability show promise for adoption of this low-cost intervention.

Parents reported that they enjoyed receiving text messages related to F&V intake, and expressed particular satisfaction with texts about sales and recipes, as well as the reassurance of receiving reminders and encouragement to serve more F&V. The most frequently used word to describe what parents liked most about the program was "ideas." Parents felt the program provided ideas for new ways to prepare and serve F&V, which may indicate feelings of ownership of the information provided. Although quantitative measures detected no changes in self-efficacy, these qualitative findings suggest improvements. According to the SCT, individuals with a sense of self-efficacy feel more capable of changing their behavior, despite barriers[29]. Hence, this program may have inspired confidence in parents to incorporate more F&V into their diets.

Most parents described the foods their child eats as somewhat or very healthy (91.6%), and reported serving meals with F&V very often or always (70.9%). However, less than half reported that they were already serving the recommended amounts of fruits (44.4%) and vegetables (31.9%) a day, indicating that there is still room to improve behaviors related to F&V intake in this population. While

parents may recognize that F&V are an important part of a healthy diet, they may not be aware of the daily recommended amounts for children.

Our last finding was that there was no change in pre-post measures, which may be due to the small sample size of this pilot study. It is also possible that the number of text messages sent, the intervention duration, or both, may have been insufficient to observe the desired effects. Although the use of text message-based interventions for health behavior change has increased in recent years[18], it is possible that text messaging is not sufficient as a stand-alone intervention to increase F&V intake.

Many other interventions utilizing text messaging have provided supplementary materials and services in addition to text messages. Examples include interactive websites[11], consultations or education sessions before or during the intervention[12], printed materials[13], and self-monitoring via text, website, or written diary[14]. Additionally, many text message-based interventions are implemented in a clinical setting to improve clinical care outcomes, hence, participants receive the standard of care plus text messaging[15-17]. The promising effects of such interventions are likely the synergistic effects of multiple components, as these studies did not isolate the effects of text messaging on outcomes. However, electronically delivered health interventions have shown promise for effecting change in dietary behaviors, such as F&V intake[21,30]. For example, an evaluation of wichealth.org, an Internet-based nutrition education program for WIC clients, found that the website had a positive impact on stage of change movement associated with parent-child feeding behaviors[31]. It is unknown whether and to what extent supplementary materials such as websites, education sessions, or mailed brochures would contribute to this intervention. Future research is needed to explore whether such materials would strengthen intervention effects.

One limitation of this study is that participants were relatively homogenous, and only half were considered low-income according to the proxy measure of whether food assistance was received in the last 12 months. Future research should target more diverse populations, which would provide important insights into cultural and community differences of how the program is perceived, which will expand generalizability of the program. Additionally, due to the voluntary nature of participation, participants

may have been more interested in nutrition than the general population, which may have resulted in higher reported satisfaction with the intervention.

2.6 Implications for Research and Practice

The findings from the current research demonstrate that a text messaging intervention to promote F&V intake created positive perceptions of changes in behavior among parents of young children. High levels of satisfaction with the intervention support the use of text messaging to complement federal food assistance programs, such as SNAP or WIC, that deliver nutrition education with limited funding to millions of people. By using text messaging, time-constrained staff can effectively reach a large number of clients. Additionally, incorporating text messaging into SNAP or WIC programming would support the federal priority to move toward public health approaches and may increase satisfaction with existing nutrition education by providing information in a format that clients prefer[32].

Table 2.1 Development of Txt4HappyKids using the Social Cognitive Theory (SCT)

Social Cognitive Theory Factors	Predictive Factor	Example Text
Personal	Knowledge: Provide information about the health benefits of eating fruit and vegetables	Eating fruits & veggies helps your child build strong muscles and bones. Give your child the gift of health by serving fruits & veggies with every meal.
	Preference: Portray fruit and vegetables as tasting good and something children enjoy eating	Apples are on sale for 1.49/lb @ Fred Meyer! Peel, core & chop. Add water & ground cinnamon. Cook for 30 min until soft, then mash. Kids love warm applesauce!
	Time: Portray shopping and cooking with children as a great way to spend quality time together	Kids love to be helpful! Let them help with dinner by washing the fruits & veggies, stirring, or measuring. This is a great way to spend quality time together!
Behavioral	Self-efficacy: Improve skills related to preparing fruit and vegetables by providing recipes and other tips	Frozen broccoli has as much fiber as fresh broccoli! Microwave until tender & toss with some olive oil, lemon juice, garlic powder, salt & pepper!
Environmental	Cost: Announce sales at grocery stores so more fruit and vegetables are available at home	Satsuma Mandarins are on sale @ Fred Meyer for $5.99/5 lb box! Keep your kids on the fast track to health with this sweet snack that is quick & easy to eat.
	Role models: Motivate parents to be positive role models for their children by eating fruit and vegetables	Your kids look up to you! Set another good example for your kids by eating fruits & veggies with your meals & as snacks.

Table 2.2 Demographic Characteristics of Participants in the Txt4HappyKids Intervention

Variable	Percent (%)
Sex (n=71)	
% Female	99
Race (n=72)	
White	69
Alaska Native	13
Other	18
Age (n=74)	
Under 25 years	18
25-34 years	50
35-44 years	23
45-54 years	10
Education (n=73)	
No College	21
Some College	80
Child Age[b] (n=72)	
Under 5 years	72
Between 5-8 years	56
Between 9-17 years	33
Income Proxy (n=72)	
Food Assistance[a]	49

[a]Received food assistance in the last 12 months from the Supplemental Nutrition Assistance Program for Women, Infants, and Children; emergency food banks, food pantry, soup kitchen; and/or meals served at a food kitchen or community site

[b]Categories for child age were not mutually exclusive

Table 2.3 Changes in Behavior, Behavioral Intent, Self-Efficacy, Attitudes, and Perceived Barriers related to Fruit and Vegetable Intake

Measure (n=72)	Pre-Intervention Median Score	Post-Intervention Median Score	Wilcoxon Signed-Rank Test Asymptotic *p*-value
Behavior[a]	3.50	3.63	0.48
Behavioral Intent[b]	4.50	4.50	0.45
Self-Efficacy[c]	4.00	4.00	0.39
Attitudes[c]	4.60	4.70	0.40
Perceived Barriers[c]	4.00	3.86	0.60

[a]Response options ranged from 1 (rarely) to 5 (always)
[b]Response options ranged from 1 (I am not thinking about serving my child more fruit and vegetables) to 5 (I am already serving my child 1 or more cups of fruit and vegetables a day)
[c]Response options ranged from 1 (strongly disagree) to 5 (strongly agree)

2.7 References

1. Wolfenden L, Wyse RJ, Britton BI, Campbell KJ, Hodder RK, Stacey FG, et al. Interventions for increasing fruit and vegetable consumption in children aged 5 years and under. *Cochrane Database Syst Rev*. 2014.
2. United States Department of Agriculture Food and Nutrition Service. Food and Nutrition Service Program Data. 2015. http://www.fns.usda.gov/data-and-statistics. Accessed September 16, 2015.
3. Duggan M. Cell Phone Activities. *Pew Research Center*. 2013. http://pewinternet.org/Reports/2013Cell-Activities.aspx. Accessed December 9, 2014.
4. Gates A, Stephens J, Artiga S. Profiles of Medicaid Outreach and Enrollment Strategies: Using Text Messaging to Reach and Enroll Uninsured Individuals into Medicaid and CHIP. *The Kaiser Commission on Medicaid and the Uninsured, Issue Brief*. 2014.
5. Smith A. The Best (and Worst) of Mobile Connectivity. Pew Research Center. 2012. http://www.pewinternet.org/2012/11/30/the-best-and-worst-of-mobile-connectivity/. Accessed June 9, 2015.
6. SinglePoint and mobile^{SQUARED}. Conversational Advertising. 2010. http://mobilesquared.co.uk/media/27820/Conversational-Advertising_SinglePoint_2010.pdf. Accessed December 9, 2014.
7. Tate EB, Spruijt-Metz D, Dunton GF. mHealth approaches to child obesity prevention: successes, unique challenges, and next directions. *Transl Behav Med*. 2013;3(4):406-15.
8. United States Department of Agriculture Food and Nutrition Service and the National Collaborative on Childhood Obesity Research. SNAP-Ed Strategies and Interventions: An Obesity Prevention Toolkit for States; Evidence-based Policy and Environmental Change in Child Care, School, Community, and Family Settings. July, 2013. https://snaped.fns.usda.gov/snap/SNAP-EdInterventionsToolkit.pdf. Accessed November 16, 2015.

9. Braunscheidel E, Grutzmacher S, DiBari J. Text2BHealthy: Development and evaluation of a text message-based nutrition education program. Conference Paper: 140st APHA Annual Meeting and Exposition 2012.
10. Text4Baby and WIC: Building on a Shared Mission. https://wicworks.fns.usda.gov/wicworks//Learning_Center/mailing/t4bWIC.pdf. Accessed August 5, 2015.
11. Hurling R, Catt M, Boni MD, Fairley BW, Hurst T, Murray P, et al. Using internet and mobile phone technology to deliver an automated physical activity program: randomized controlled trial. *J Med Internet Res.* 2007;9(2):e7.
12. Kwon HS, Cho JH, Lee JH, Song BR, Oh JA, Han JH, et al. Development of web-based diabetic patient management system using short message service (SMS). *Diabetes Res Clin Pract.* 2004;66:S133-7.
13. Patrick K, Raab F, Adams MA, Dillon L, Zabinski M, Rock CL, et al. A text message-based intervention for weight loss: randomized controlled trial. *J Med Internet Res*. 2009;11(1):e1.
14. Shapiro JR, Bauer S, Hamer RM, Kordy H, Ward D, Bulik CM. Use of text messaging for monitoring sugar-sweetened beverages, physical activity, and screen time in children: a pilot study. *J Nutr Educ Behav.* 2008;40(6):385-391.
15. Márquez Contreras E, de la Figuera von Wichmann M, Gil Guillén V, Ylla-Catalá A, Figueras M, Balaña M, et al. Effectiveness of an intervention to provide information to patients with hypertension as short text messages and reminders sent to their mobile phone (HTA-Alert). *Aten Primaria*. 2004;34(8):399-405
16. Franklin V, Waller A, Pagliari C, Greene S. "Sweet Talk": text messaging support for intensive insulin therapy for young people with diabetes. *Diabetes Technol Ther*. 2003;5(6):991-996.
17. Hanauer DA, Wentzell K, Laffel N, Laffel LM. Computerized Automated Reminder Diabetes System (CARDS): E-Mail and SMS Cell Phone Text Messaging Reminders to Support Diabetes Management. 2009. *Diabetes Technol Ther*. 2009;11(2):99-106.

18. Fjeldsoe BS, Marshall AL, Miller YD. Behavior change interventions delivered by mobile telephone short-message service. *Am J Prev Med*. 2009;36(2):165-173.
19. Vodopivec-Jamsek V, de Jongh T, Gurol-Urganci I, Atun R, Car J. Mobile phone messaging for preventive health care. *Cochrane Database Syst Rev.* 2012;12:CD007457.
20. Pedersen S, Grønhøj A, Thøgersen J. Texting your way to healthier eating? Effects of participating in a feedback intervention using text messaging on adolescents' fruit and vegetable intake. *Health Educ Res*. 2016:31(2):171-84.
21. Rompotis CJ, Grove JR, Byrne SM. Benefits of habit-based informational interventions: a randomised controlled trial of fruit and vegetable consumption. *Aust NZ J Public Health*. 2014;38:247-52.
22. State of Alaska Department of Health and Social Services, State of Alaska Family Nutrition Program, and University of Alaska Fairbanks. Alaska SNAP-Ed Needs Assessment.2014. http://dhss.alaska.gov/dpa/Documents/dpa/pdf/Alaska_SNAP_needs_assessment_report. pdf. Accessed November 16, 2015.
23. Bandura A. *Social foundations of thought and action*. Englewood Cliffs, NJ: Prentice Hall. 1986.
24. U.S. Department of Health and Human Services. TXT4Tots Message Library. http://www.hrsa.gov/healthit/txt4tots/. Accessed January 13, 2014.
25. Sylva K, Townsend MS, Martin A, Metz D. Food Stamp Program Fruit and Vegetable Checklist. Public Health Institute, California Department of Health. 2006. http://townsendlab.ucdavis.edu/PDF_files/FV/FSP_FV_book.pdf. Accessed November 16, 2015.
26. Townsend MS, Kaiser LL. University of California Fruit and Vegetable Inventory. University of California Cooperative Extension. 2006. https://www.cdph.ca.gov/programs/cpns/Documents/FruitandVegetableInventory.pdf. Accessed November 16, 2015.

27. IBM Corp. IBM SPSS Statistics for Windows, Version 19.0. Released 2010. Armonk, NY: IBM Corp.
28. Elo S, Kyngäs H. The qualitative content analysis process. *J Adv Nurs*. 2008;62(1):107-15.
29. Bandura A. Social cognitive theory: An agentic perspective. *Asian J Soc Psychol*. 1999;2:21 41.
30. Norman GJ, Zabinski MF, Adams MA, Rosenberg DE, Yaroch AL, Atienza AA. A Review of eHealth Interventions for Physical Activity and Dietary Behavior Change. *Am J Prev Med.* 2007;33(4):336-345.
31. Bensley RJ, Brusk JJ, Anderson JV, Mercer N, Rivas J, Broadbent LN. wichealth.org: Impact of a Stages of Change-Based Internet Nutrition Education Program. *J Nutr Educ Behav*. 2006;38(4):222-229.
32. Bensley RJ, Hovis A, Horton KD, Loyo JJ, Bensley KM, Phillips D, et al. Accessibility and preferred use of online Web applications among WIC participants with Internet access. *J Nutr Educ Behav*. 2014;46(3):S87-92.

Chapter 3: Exploring the Potential for Technology-Based Nutrition Education among WIC Recipients in Remote Alaska Native Communities[1]

3.1 Abstract

Objective: Estimate media technology use among WIC participants in Alaska Native communities to understand feasibility of technology-based nutrition education.

Design: Self-administered, mailed questionnaire.

Setting and Participants: Random selection of approximately 50% of WIC authorized representatives in rural and remote Alaska Native communities in the Yukon-Kuskokwim River Delta in Alaska (n=975).

Main Outcome Measures: Media technology use and barriers to use, interest in media technology-based nutrition education and potential barriers.

Analysis: Frequencies and a one-way ANOVA to investigate effect of age on outcome measures.

Results: The response rate was 37.7% (N=368). Respondents were primarily Alaska Native (99.1%) women (97.5%) between 18-29 years of age (56.6%). Smartphone (78.8%) and Facebook (80.3 %) use were comparable to national averages, but having a computer at home (38.4%) was much less likely. Respondents reported a preference to receive nutrition information via Facebook (59.7%) and e-mail (41.1%). Potential barriers included slow Internet (51.0%), no computer access (42.1%), and high cost of Internet (35.1%).

Conclusions and Implications: These findings shed light on new opportunities to reach this rural and remote population and will guide technology-based nutrition education efforts in Alaska. Media technology, especially mobile devices, is a viable way for WIC and other programs to deliver nutrition education to Alaska Native people in remote communities.

3.2 Introduction

American Indians and Alaska Natives have the highest prevalence of diabetes and obesity compared to any other ethnic group in the United States[1]. However, this trend is relatively recent.

[1] Power JM, Braun KL, Bersamin A. Exploring the Potential for Technology-Based Nutrition Education among WIC Recipients in Remote Alaska Native Communities. Submitted to the Journal of Nutrition Education and Behavior. 2016.

Mortality from coronary heart disease (CHD) was significantly lower among Alaska Native people than nonnative Alaskans before 1990[2]. Now, risk factors for CHD, such as hypertension, overweight, smoking, and sedentary lifestyle are significantly more prevalent among Alaska Native people. One explanation for this shift is increased consumption of highly processed, imported, market foods rather than nutrient-dense, traditional, subsistence foods[3]. Another related explanation is less familiarity with healthy market foods. In Alaska Native communities, subsistence foods are steeped in rich history, connecting the traditional lifestyle to the land and wildlife both physically and socially, and shaping the Alaska Native world-view[4]. Imported market foods do not carry this same cultural significance[4], which may result in a lack of knowledge about how to make healthy food choices. Low population density in rural and remote Alaska Native communities (less than one person per square mile) combined with lack of affordable travel between these communities make delivering in-person nutrition education to this population prohibitively expensive[5]. Developing and testing cost-effective public health approaches to deliver nutrition education to Alaska Native people, particularly those living in rural areas, should be prioritized due to the significant health disparities experienced by this population.

Media technology, such as the Internet and cell phones, offers new ways to communicate about health issues and to promote health and well-being. According to the Pew Research Center Internet & American Life Project, 84% of American adults used the internet in 2015[6], and 90% of American adults owned a cell phone in 2014[7]. There is a growing body of evidence demonstrating that web-based and computer-delivered interventions have the potential to improve knowledge and behavioral health outcomes, such as physical activity, nutrition, tobacco use, and safe sexual behavior[8-11]. Text messaging has also grown in popularity as an effective platform to promote health behaviors[12]. Compared to traditional face-to-face counseling, technology-based nutrition education could reduce health service costs and reach a greater proportion of Alaska Native people living in rural communities. Additionally, technology-based nutrition education tailored to Alaska Native people may increase the availability of acceptable materials for these communities. Evidence shows that nutrition education messages that are well tailored for the target population are more effective than non-tailored materials in promoting

behavior change[13]. Due to limited access to nutrition professionals in rural Alaska, a culturally tailored technology-based approach may present the best opportunity to provide individualized nutrition education at a relatively low cost[14].

Few technology-based nutrition education programs have been developed for or evaluated in Alaska Native populations, and the extent to which Alaska Native people living in rural Alaska use media technology is unknown. To guide the development of technology-based health interventions, research is needed to identify appropriate technologies and intervention strategies, health-seeking preferences, and other factors that might impact the implementation and sustainability of such programs in rural, tribal settings.

The primary objective of this study is to assess the use of media technology among participants of the Special Supplemental Nutrition Assistance Program for Women, Infants, and Children (WIC) living in rural Alaska Native communities. WIC participants are an ideal population for this study because of the potential to reach a large number of participants and their families through WIC education. Findings from this study will inform future, technology-based nutrition education efforts in the region.

3.3 Methods

3.3.1 Sample

Using a cross-sectional study design, 975 WIC authorized representatives (of 1,992 in the region, or 48.9%) in the Yukon Kuskokwim River Delta (YKD) in southwestern Alaska were randomly selected and mailed a self-administered questionnaire. A WIC authorized representative has permission to act on behalf of a WIC participant, although he or she may not be eligible for WIC benefits. The YKD is home to approximately 25,000 Alaskan Native people, the majority of whom live in rural communities (population <1000) that are only accessible by plane year round or boat in the summer[5]. This region is predominantly Alaska Native (81.5%), and more than one third of families fall below the national poverty level. The prevalence of overweight and obesity is high (>50%), and less than 20% of the population meets daily fruit and vegetable (F&V) recommendations[5]. This study was approved by the University of

Alaska Fairbanks Institutional Review Board and the Yukon-Kuskokwim Health Corporation (YKHC) Human Studies Committee.

3.3.2 Measures

The questionnaire included 19 items asking about current media technology use, barriers to media technology use, interest in media technology-based nutrition education, and potential barriers to media technology-based nutrition education. Survey questions were drawn from two national surveys and one survey designed to assess technology use among WIC participants with Internet access[15-17]. Some study-specific questions were also added. Current practices were assessed by asking participants if they (a) own a cell phone, smart phone, computer, DVD player, tablet, or digital camera; (b) have a text messaging plan, data plan, Internet access at home, or Internet access in their community; and the frequency with which participants (c) instant message, email, text, use Facebook, use Twitter, watch videos, play games, post videos/photos online, or participate in video calls. A technology-use score, an aggregate of the number of different types of media technology used and the frequency of use, was calculated for each participant. Possible scores ranged from 0 to 40, with 0 indicating that no media technologies are used ever and 40 indicating that all media technologies are used at least once daily.

Interest in media technology-based nutrition education was assessed by asking participants if they (a) think it would be useful to get nutrition information on a phone or computer; (b) are interested in receiving nutrition information via email, text message, Facebook, online videos, DVD/CD-ROM, online FAQs, or video chat; (c) are interested in joining an online group to talk about pregnancy, breastfeeding, parenting, fruits/vegetables, healthy beverages, picky eaters, active playtime, weight loss, or exercise; and (d) are interested in communicating with other parents about nutrition topics via email, Facebook, or Twitter. A question to identify potential barriers to receiving nutrition information through media technology was also included. Demographic information such as age, race, sex, education level, and participation in the Supplemental Nutrition Assistance Program (SNAP) was also collected.

The questionnaire was reviewed by the YKHC and the State of Alaska WIC Program to ensure that content was appropriate for the target population.

3.3.3 Procedures

The Tailored Design Method (TDM) guided questionnaire distribution. This method emphasizes personalizing survey materials and making several contacts with participants, either via mail or Internet, to build trust with researchers and improve response rates[18]. Examples of personalization include using names on address labels, putting stamps on survey envelopes, and including signed cover letters. Three contacts were made to participants via mail approximately 2-3 days apart. The first contact consisted of a postcard saying that a questionnaire would arrive and stressing the importance of the addressee's response. A few days later, potential participants received the questionnaire and a stamped and addressed return envelope, along with $2. This was followed a few days later with a thank-you postcard and reminder to return the completed questionnaire. Participants were asked to return their completed surveys within one month.

3.3.4 Data Analysis

SPSS Software[19] was used to conduct the analysis. Frequencies were calculated to determine participant demographics and response patterns. A one-way ANOVA was used to investigate whether the categorical variable of age group had an effect on internet use, access to technologies, frequency of technology use, and perceived usefulness of technology-based nutrition education.

3.4 Results

3.4.1 Respondent Characteristics

Of the 975 randomly selected participants, 368 (37.7%) responded. This number represents about 20% of all WIC participants in the YKD. Almost all respondents were Alaska Native (99.4%) women (97.5%) (Table 3.1). More than half (56.6%) of participants were 18-29 years old, 36.7% were 30-49 years, and 6.7% were age 50 or older. More than 20% of participants did not complete high school, 61.0% had a high school degree, and 17.7% had attended some college. In addition to WIC, 57.7% of respondents also received food assistance from SNAP.

3.4.2 Media Technology Use

Media technology use was common. Respondents reported having access to a wide variety of media technologies such as smartphones (78.8%), tablets (44.8%), and computers (38.4%). Respondents reported using media technologies for a variety of activities at least once per week or more frequently, including text messaging (93.3%), Facebook (80.3%), instant messaging (62.4%), and email (50.0%) (Figure 3.1). Less than 3% of respondents reported that they never used text messaging. Of respondents who used text messaging, 83.6% had an unlimited text messaging plan. Of respondents who used data, 34.7% had an unlimited data plan. Altogether, 80.3% of respondents used the Internet, and while only 42.6% of Internet users could connect from home, 75.5% could connect from somewhere in their community. Of the 63 respondents that did not use the Internet, the most common barriers to use included no Internet access (36.4%), no computer access (28.8%), and the high cost of Internet (13.6%). Only 2 (3%) respondents that did not use the Internet reported that they were just not interested.

The mean technology-use score among respondents was 17.60 out of 40 points, reflecting the fact that respondents used some technologies frequently (e.g. Facebook, text messaging, instant messaging), while other technologies were hardly ever used (e.g. Twitter, YouTube, video chatting), as shown in Figure 3.1.

A one-way ANOVA was conducted to compare the effect of age on Internet use, access to technologies, frequency of technology use, and perceived usefulness of technology-based nutrition education. There was a significant effect of age on Internet use [$F(2,353) = 8.90$, $p < 0.01$]; access to a smart phone [$F(2,355) = 5.43$, $p < 0.01$] but not a tablet or computer; and frequency of Facebook [$F(2,358) = 9.85$, $p < 0.01$], e-mail [$F(2,355) = 4.78$, $p < 0.01$], and text message use [$F(2,357) = 14.25$, $p < 0.01$]. Post hoc comparisons using the Tukey's HSD indicated that younger respondents used Facebook, e-mail, and text messaging significantly more frequently than older respondents. Means, standard deviations, and post hoc comparisons are reported in Table 3.2.

3.4.3 Interest in Media Technology-Based Nutrition Education

Altogether, 85.8% of respondents thought it would be somewhat or very useful to get nutrition information on a phone or computer. Some of the most popular ways respondents indicated they would be somewhat or very interested in receiving nutrition information was through e-mail (67.8%), online videos (60.4%), Facebook (58.0%), and text message (54.4%). The least popular way was through video chat, with almost three-quarters of respondents indicating that they were not at all interested (73.6%) (Table 3.3). When asked which nutrition topics were preferred for a parent-oriented online group, respondents expressed the most interest in active playtime (67.1%), healthy beverages (66.3%), exercise (66.1%), fruits and vegetables (65%), and parenting (62.9%) (Table 3.3). To communicate with other parents about such nutrition topics, respondents were interested in using Facebook (59.7%) and email (41.1%). Less than 10% of respondents expressed any interest in using Twitter to communicate with other parents. Potential barriers to receiving nutrition information via media technology included slow Internet (50.1%), no computer access (41.7%), and the high cost of Internet (34.9%).

3.5 Discussion

This is the first study to explore the potential of using media technology to deliver nutrition information to Alaska Native people in remote communities, a population with a recognized need for nutrition education. Overall, technology use was common among Alaska Native WIC participants in the YKD, indicating that technology is indeed a feasible way to deliver nutrition education. In particular, levels of smartphone use were comparable to that of the general U.S. population (78.8% compared with 68.0% nationally)[20]. However, participants with smartphones were less than half as likely as the general U.S. population to have Internet access at home (41% compared with 90% nationally)[21]. In addition, only 38.4% of respondents reported having a computer compared with 73.0% nationally[20].

Our finding that younger respondents used Facebook, e-mail, and text messaging more frequently than older respondents is consistent with national Internet use patterns[6]. These data suggest that technology-based nutrition education may be particularly effective among young adults. Almost twice as many 18-29 year olds had access to a computer (40.2%) or smartphone (83.2%) compared to 50+ year

olds (21.7% and 54.5%, respectively). The WIC program serves young families (e.g. pregnant women and mothers with children age 5 or under), and more than 50% of Alaska Native WIC participants in this study were between 18-29 years old. A technology-based approach may be optimal for the Alaska Native WIC participants in the YKD who are under 30. Due to the emphasis of WIC on family, technology-mediated nutrition information may positively impact not only WIC participants, but other family and household members. Additionally, diet quality among young-adult Alaska Native people tends to be lower than among older age groups due in part to a greater reliance on highly processed commercial market foods than on nutrient-rich traditional Alaska Native foods[3]. Technology-mediated nutrition information targeted at younger populations could improve the reach of programs working to address this concern.

Alaska Native WIC participants were substantially more likely to use text messaging (93.3% compared with 73.0% nationally)[22], Facebook (80.3% compared with 72.0% nationally)[23], and some form of instant messaging (62.4% compared with 29.0% nationally)[23] than the general U.S. population. This finding suggests that nutrition education delivered via these pathways is an ideal way to reach large numbers of Alaska Native WIC participants. Additionally, high levels of Facebook and text message use are consistent in other WIC populations[17]. Almost three-quarters of respondents (74.4%) reported using texting and over one-half (57.3%) reported using Facebook on a daily basis. However, results show a greater preference for receiving nutrition information via e-mail, despite less than one-quarter of respondents (19.0%) reporting daily use. Although respondents used texting and Facebook more frequently than e-mail, these technologies may be viewed as more recreational while e-mail may be viewed as more professional or work-related. However, almost one-third of respondents (31.0%) reported using e-mail at least once a week (but less than once a day). Hence, e-mail may still be a viable way to reach many Alaska Native WIC participants. As preferences will vary from person to person, nutrition information should be made available through several technology channels and designed for use on mobile devices such as smartphones or tablets, rather than on computers.

Also, nutrition education programs should limit the amount of cellular data necessary for participation, given that cost was reported as a key barrier to Internet use. Additionally, technology-based nutrition education in the YKD should be tailored to reflect the unique food environment in rural Alaska, incorporating traditional Alaska Native foods such as sea mammals, salmon and other fish, large land mammals, and wild plants, as well as commercial market foods into nutrition messages[4,24].

One limitation of this study is that our response rate of 37.7% may be considered low. Due to the anonymous nature of our survey, we were unable to follow up with non-respondents to identify any differences from respondents. It is possible that respondents had higher literacy and higher technology use levels than non-respondents, and hence were more likely to complete the survey. However, the 368 respondents represented about 20% of Alaska Native WIC authorized representatives in the YKD.

To our knowledge, a mailed survey of this magnitude has never been conducted in the YKD. While direct comparisons are not possible, annual surveys conducted by the State of Alaska WIC program to assess participant views on nutrition education and breastfeeding promotion only require a response rate of 5%, making the response rate achieved in this study substantial[25]. We believe that our partnerships with a tribal organization such as the YKHC and the State of Alaska WIC Program strengthened the research process and outcomes.

Another limitation of this study is that we did not identify whether nutrition was a priority for participants. Hence, we cannot parse if lack of interest in technology-based education was due to lack of interest in nutrition information in general. Although almost half of respondents thought that receiving nutrition information on a phone or computer would be somewhat (47.1%) or very (38.7%) useful, it is possible that perceptions of usefulness of technology-mediated information were underestimated in this study. Additionally, these findings represent data from a primarily Yup'ik population and may not generalize to other Alaska Native people living in different regions of the state.

3.6 Implication for Research and Practice

Although preliminary, these findings shed light on new opportunities to reach this rural and remote population. Previous studies have shown that Internet-based interventions for WIC participants

can increase fruit and vegetable consumption[26] and positively impact movement along stages of change for parent-child feeding behaviors[27]. Hence, technology and Internet-based nutrition education could prove effective among Alaska Native WIC participants. Findings from this study will guide technology-based nutrition education efforts in Alaska. Future studies should develop culturally relevant nutrition messages that can be delivered via media technology, and test the feasibility of message dissemination via these newly identified technology channels. Use of media technologies in SNAP and WIC programming would support the Healthy, Hunger Free Kids Act of 2010 and the federal priority to move toward evidence-based public health approaches to promote healthy eating and an active lifestyle.

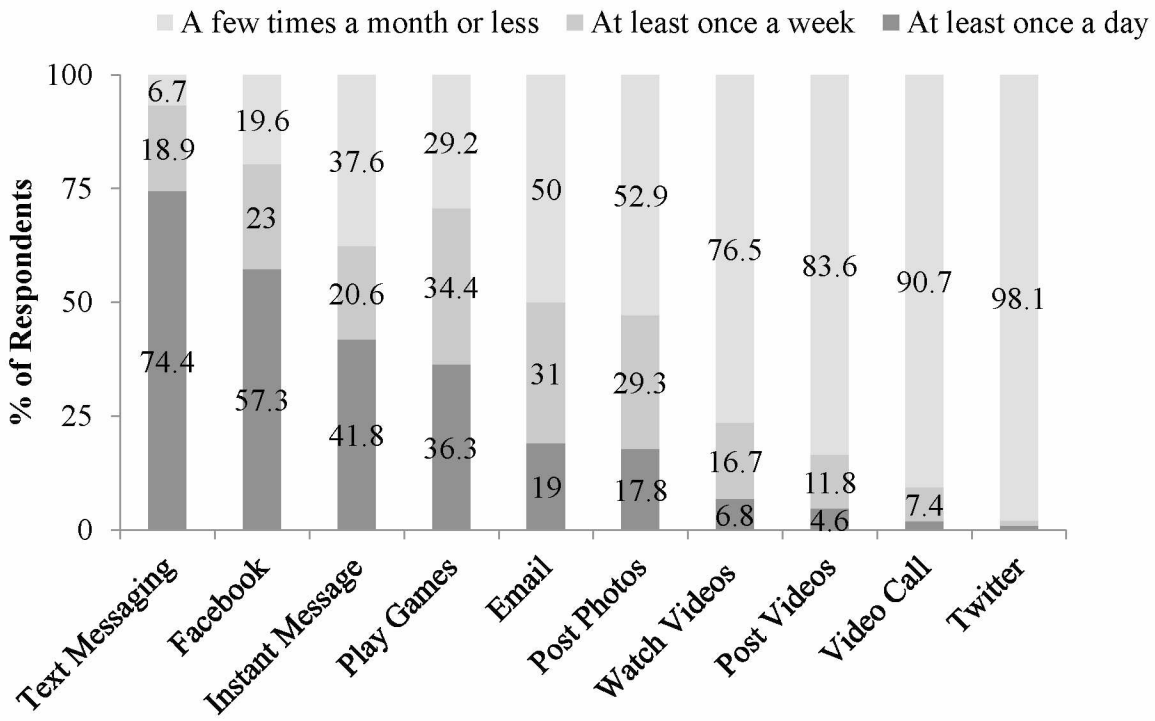

Figure 3.1 Frequency of media technology-based activities among Alaska Native WIC participants

Table 3.1 Characteristics of WIC Authorized Representative Respondents (N = 368)

Variable	Percent (%)
Sex	
Female	97.5
Race	
Alaska Native	99.4
White	1.7
Age	
18-29 years	56.6
30-49 years	36.7
50-64 years	6.1
65+ years	0.6
Education	
Elementary	3.3
Some High School	18.0
High School Graduate	61.0
Some College	17.1
College Graduate	0.6
Food Assistance	
SNAP	57.7

Table 3.2 Comparison **of** Education Level and Technology Use Characteristics Between Age Groups of Alaska Native WIC Participants

Factors	18-29 yrs Mean ± SD	30-48 yrs Mean ± SD	50+ yrs Mean ± SD
Internet Use[1]	0.84 ± 0.37[a]	0.80 ± 0.40[a]	0.48 ± 0.51[b]
Access to[2]			
Computer	0.40 ± 0.49[a]	0.39 ± 0.49[a]	0.22 ± 0.42[a]
Tablet	0.42 ± 0.49[a]	0.51 ± 0.50[a]	0.35 ± 0.50[a]
Smart phone	0.83 ± 0.38[a]	0.76 ± 0.43[ab]	0.55 ± 0.51[b]
Frequency of technology use[3]			
Facebook	3.24 ± 1.19[a]	2.88 ± 1.51[b]	2.00 ± 1.83[c]
Email	1.87 ± 1.40[a]	1.98 ± 1.52[a]	0.95 ± 1.29[b]
Texting	3.61 ± 0.82[a]	3.66 ± 0.80[a]	2.59 ± 1.68[b]
Perceived usefulness of getting nutrition information on phone or computer[4]	1.24 ± 0.70[a]	1.27 ± 0.65[a]	1.17 ± 0.76[a]

[a,b,c] Cells with the same superscript are not significantly different at the $p < .05$ level according to Tukey's HSD post hoc comparisons

[1]Response options: 0 (No, I do not) to 1 (Yes, I do)

[2]Response options: 0 (No) to 1 (Yes)

[3]Response options: 0 (Never), 1 (A few times a month or less), 2 (Once a week), 3 (A few times a week), 4 (At least once a day)

[4]Response options: 0 (Not at all useful), 1 (Somewhat useful), 2 (Very useful)

Table 3.3 Interest in nutrition education, technological channels, and topics reported by Alaska Native WIC participants		
	Somewhat or very interested (%)	**Not interested (%)**
Getting nutrition information by phone or computer[a]	85.9	14.1
Preferred channels to receive nutrition education:		
Email	67.8	32.2
Online videos	60.4	39.6
Facebook	58.0	42.0
Text message	54.4	45.6
Video chat	26.4	73.6
Preferred nutrition education topics:		
Active Playtime	67.1	32.9
Healthy Beverages	66.2	33.8
Exercise	66.0	34.0
Fruits & Vegetables	65.0	35.0
Parenting	63.0	37.0
Picky Eaters	58.5	41.5
Weight Loss	58.4	41.6
Breastfeeding	39.7	60.3
Pregnancy	36.1	63.9
[a] Response options were *"Somewhat or very useful"* and *"Not at all useful"*		

3.7 References

1. Jernigan VB, Duran B, Ahn D, Winkleby M. Changing patterns in health behaviors and risk factors related to cardiovascular disease among American Indians and Alaska Natives. *Am J Public Health*. 2010 Apr;100(4):677-83.
2. McLaughlin JB, Middaugh JP, Utermohle CJ, Asay ED, Fenaughty AM, Eberhart-Phillips JE. Changing patterns of risk factors and mortality for coronary heart disease among Alaska Natives, 1979-2002. *JAMA*. 2004 Jun 2;291(21):2545-6.
3. Bersamin A, Luick BR, Ruppert E, Stern JS, Zidenberg-Cherr S. Diet Quality Among Yup'ik Eskimos Living in Rural Communities is Low: The Center for Alaska Native Health Research Pilot Study. *J Am Diet Assoc*. 2006;106:1055-1063.
4. Loring PA, Gerlach SC. Food, culture, and human health in Alaska: an integrative health approach to food security. *Environ Sci Policy*. 2008;12(4):466-78.
5. State of Alaska Department of Health and Social Services, State of Alaska Family Nutrition Program, and University of Alaska Fairbanks. Alaska SNAP-Ed Needs Assessment.2014. http://dhss.alaska.gov/dpa/Documents/dpa/pdf/Alaska_SNAP_needs_assessment_report.pdf. Accessed November 16, 2015.
6. Perrin A, Duggan M. Americans' Internet Access: 2000-2015. Pew Research Center. 2015. http://www.pewinternet.org/2015/06/26/americans-internet-access-2000-2015/. Accessed September 29, 2015.
7. Pew Research Center. Mobile Technology Fact Sheet. 2014. http://www.pewinternet.org/fact-sheets/mobile-technology-fact-sheet/. Accessed September 29, 2015.
8. Portnoy DB, Scott-Sheldon L, Johnson BT, Carey MP. Computer-delivered interventions for health promotion and behavioral risk reduction: A meta-analysis of 75 randomized controlled trials, 1988-2007. *Prev Med*. 2008;47:3-16.

9. Norman GJ, Zabinski MF, Adams MA, Rosenberg DE, Yaroch AL, Atienza AA. A Review of eHealth Interventions for Physical Activity and Dietary Behavior Change. *Am J Prev Med*. 2007;33(4):336-345.
10. Broekhuizen K, Kroeze W, van Poppel M, Oeneme A, Brug J. A Systematic Review of Randomized Controlled Trials on the Effectiveness of Computer-Tailored Physical Activity and Dietary Behavior Promotion Programs: an Update. *Ann Behav Med*. 2012;44:259-286.
11. Wantland DJ, Portillo CJ, Holzemer WL, Slaughter R, McGhee EM. The Effectiveness of Web-Based vs. Non-Web-Based Interventions: A Meta-Analysis of Behavioral Change Outcomes. *J Med Internet Res*. 2004;6(4):e40.
12. Fjeldsoe BS, Marshall AL, Miller YD. Behavior change interventions delivered by mobile telephone short-message service. *Am J Prev Med*. 2009;36(2):165-173.
13. Campbell MK, DeVellis BM, Strecher VJ, Ammerman AS, DeVellis RF, Sandler, RS. Improving Dietary Behavior: The Effectiveness of Tailored Messages in Primary Care Settings. *Am J Public Health*. 1994;84(5): 783-787.
14. Brug J, Oenema A, Campbell M. Past, present, and future of computer-tailored nutrition education. *Am J Clin Nutr*. 2003;77(suppl):1028S-34S.
15. Princeton Survey Research Associates for the Pew Internet & American Life Project. Health Care and the Internet Survey. 2000. http://www.pewinternet.org/files/old-media/Files/Questionnaire/Old/PIP_Health_Questionnaire.pdf. Accessed August 26, 2015.
16. Princeton Survey Research Associates for the Pew Internet & American Life Project. Health Tracking Survey. 2012. http://www.pewinternet.org/files/old-media/Files/Questionnaire/2012/PIP_MobileHealth2012_SurveyQuestions.pdf. Accessed August 26, 2015.
17. Bensley RJ, Hovis A, Horton KD, Loyo JJ, Bensley KM, Phillips D, et al. Accessibility and preferred use of online Web applications among WIC participants with Internet access. *J Nutr Educ Behav*. 2014;46(3):S87-92.

18. Dillman DA. *Mail and Internet Surveys: The Tailored Design Method, 2007 Update*. New York, NY: John Wiley & Sons, Inc; 2007.
19. IBM Corp. IBM SPSS Statistics for Windows, Version 19.0. Released 2010. Armonk, NY: IBM Corp.
20. Anderson M. Technology Device Ownership: 2015. Pew Research Center. 2015. http://www.pewinternet.org/2015/10/29/technology-device-ownership-2015. Accessed April 13, 2016.
21. Smith A. U.S. Smartphone Use in 2015. Pew Research Center. 2015. http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/Pew Internet & American Life Project. Accessed April 13, 2016.
22. Smith A. Americans and text messaging. Pew Research Center. 2011. http://www.pewinternet.org/2011/09/19/americans-and-text-messaging/. Accessed June 29, 2016.
23. Duggan M. Mobile Messaging and Social Media 2015. Pew Research Center. 2015. http://www.pewinternet.org/2015/08/19/mobile-messaging-and-social-media-2015/. Accessed April 13, 2016.
24. Johnson JS, Nobmann ED, Asay E. Factors related to fruit, vegetable and traditional food consumption which may affect health among Alaska Native People in Western Alaska. *Int J Circumpolar Health*. 2012;71:17345.
25. State of Alaska Special Supplemental Nutrition Assistance Program for Women, Infants, and Children. Alaska WIC Policy: Chapter 2 Nutrition Services.2015. http://dhss.alaska.gov/dpa/Documents/dpa/programs/nutri/downloads/Admin/PolicyandProcedures/Admin_PandP_Ch2.pdf. Accessed May 17, 2016.
26. Bensley RJ, Anderson JV, Brusk JJ, Mercer N, Rivas J. Impact of Internet vs Traditional Special Supplemental Nutrition Program for Women, Infants, and Children Nutrition Education on Fruit and Vegetable Intake. *J Am Diet Assoc*. 2010;11:1723-1727.

27. Bensley RJ, Brusk JJ, Anderson JV, Mercer N, Rivas J, Broadbent LN. wichealth.org: Impact of a Stages of Change-Based Internet Nutrition Education Program. *J Nutr Educ Behav*. 2006;38(4):222-229.

Chapter 4: Conclusion

The federally funded Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is an effective way to improve nutrient intake and birth outcomes for WIC recipients[1-6]. However, the extent to which WIC nutrition education has a positive impact on Alaska Native participants is unclear. Developing nutrition education materials that are tailored for Alaska Native people, especially those living in rural and remote communities, is an important first step in reducing the prevalence of nutrition-related health disparities experienced by this population[7].

Although the WIC program (education + provision of food) has been shown to positively impact participants, the extent to which nutrition education contributes to these overall programmatic effects is unknown. A rigorous evaluation of WIC nutrition education alone has not been conducted and is made difficult by variations in program implementation and participant characteristics between states[6]. Evidence supporting the effectiveness of WIC nutrition education is mixed, with some studies showing only modest impacts at best[8,9]. Enhancement of nutrition education services, such as the personalization of counseling sessions to meet individual needs, could maximize effectiveness by improving participant engagement and follow-up[10]. However, such programmatic changes would be costly, and with total program spending for nutrition services and administrative costs capped at $12 per participant, there is not enough funding to meaningfully change in-person WIC nutrition education[10].

Such budget constraints are particularly restrictive in Alaska, where much of the WIC population who could benefit the most from nutrition education lives in rural and remote Alaska Native communities that are not connected to the road system[7]. A more cost-effective way to reach this population with more personalized nutrition information is through media technology[11]. Technology-based interventions and prevention programs have been shown to produce significant, positive changes in knowledge, attitudes, intentions and behaviors related to a variety of public health issues, including physical activity and nutrition[12-14]. Delivering nutrition information on a computer or mobile device could not only increase convenience and participant satisfaction, but also reduce wait times at WIC clinics, allow nutrition

educators to more effectively manage their time, and reduce overall programmatic costs associated with nutrition education[15].

This thesis presented evidence that supports the use of technology-based nutrition education as an acceptable and feasible alternative to traditional face-to-face nutrition counseling in Alaska. The second chapter presents evidence that text messaging is an acceptable way to deliver nutrition information to parents with young children. The majority of parents who participated in the Txt4HappyKids intervention felt positively impacted and reported high satisfaction. Parents were engaged with the text messages and receptive to nutrition information, despite the lack of face-to-face interaction. This finding is important because engagement is key to intervention efficacy, and greater participant engagement in a text message-based nutrition intervention can result in more meaningful intervention effects[16]. Parents reported that the program provided ideas for new ways to eat fruits and vegetables, suggesting improvements in parent self-efficacy, an important component of behavior change[17]. These findings show promise for adoption of the Txt4HappyKids intervention.

The third chapter of this dissertation provides evidence that media technology is a feasible way to reach many Alaska Native WIC participants in rural and remote Alaskan communities. Smartphone use in the Yukon-Kuskokwim (YK) Delta was comparable to national averages (78.8% compared with 68.0% nationally), although less than half of respondents reported having access to a computer (38.4% compared with 73.0% nationally)[18]. Hence, mobile devices would be an ideal way to reach the greatest number of WIC participants in this region.

Respondents with smartphones were less than half as likely as the general U.S. population to have Internet access at home (41% compared with 90% nationally)[19]. Nevertheless, respondents were substantially more likely to use Facebook (80.3% compared with 72.0% nationally)[20] and text messaging (93.3% compared with 73.0% nationally)[21]. These findings suggest that nutrition education delivered through Facebook or text message would be an ideal way to reach large numbers of Alaska Native WIC participants. Potential barriers to receiving nutrition information via media technology included slow Internet (50.1%), no computer access (41.7%), and the high cost of Internet (34.9%), indicating that

nutrition education programs should limit the amount of cellular data necessary for participation. These findings show that despite barriers, media technology is a viable way to reach many Alaska Native WIC participants living in rural and remote communities.

In summary, this thesis provided important evidence to support the use of text messaging and other media technology in nutrition education efforts by WIC and other federal food assistance programs for Alaska Native people living in rural and remote communities. These findings will inform technology-based nutrition education efforts throughout Alaska that should be evaluated using rigorous methods. The findings from this thesis are relevant not only to WIC, but also to other stakeholders including state and tribal organizations working throughout Alaska on a range of issues, from decreasing sugar-sweetened beverage consumption in rural communities to increasing attendance at local farmers' markets statewide. Likewise, findings apply not only to nutrition education development, but also to a wide variety of public health efforts in Alaska and for rural populations as a whole.

4.1 References

1. Basiotis P, Kramer-LeBlanc C, Kennedy E. Maintaining Nutrition Security and Diet Quality: the Role of the Food Stamp Program and WIC. *Fam Econ Nutr Rev*. 1998;11:4-16.
2. Khanani I, Elam J, Hearn R, Jones C, Maseru N. The Impact of Prenatal WIC Participation on Infant Mortality and Racial Disparities. *Am J Public Health*. 2010;100(S1):S204-09.
3. Kowaleski-Jones L, Duncan GJ. Effects of Participation in the WIC Program on Birthweight: Evidence from the National Longitudinal Survey of Youth. *Am J Public Health*. 2002;92(5):799-804.
4. Sherry B, Mei Z, Yip R. Continuation of the decline in prevalence of anemia in low-income infants and children in five states. *Pediatrics*. 2001;107(4):677-82.
5. Rose D, Habicht JP, Devaney B. 1998. Household Participation in the Food Stamp and WIC Programs Increases the Nutrient Intakes of Preschool Children. *J Nutr*. 1998;128(3):548-55.

6. Oliveira V, Frazao E. The WIC Program: Background, Trends, and Economic Issues, 2009 Edition. US Department of Agriculture, Economic Research Service, Economic Research Report No. 73. April 2009.
7. State of Alaska Department of Health and Social Services, State of Alaska Family Nutrition Program, and University of Alaska Fairbanks. Alaska SNAP-Ed Needs Assessment.2014.http://dhss.alaska.gov/dpa/Documents/dpa/pdf/Alaska_SNAP_needs_assessment_report pdf. Accessed November 16, 2015.
8. Fox MK, Burstein N, Golay J, Price C. WIC Nutrition Education Assessment Study: Final Report. U.S. Department of Agriculture, Food and Nutrition Service, Office of Analysis, Nutrition and Evaluation. Alexandria, VA: 1999.
9. Ritchie LD, Whaley SE, Spector P, Gomez J, Crawford PB. Favorable Impact of Nutrition Education on California WIC Families. *J Nutr Educ Behav*. 2010;42.
10. Besharov DJ, Germanis P. Rethinking WIC: An Evaluation of the Women, Infants, and Children Program. The American Enterprise Institute (AEI) Press. 2001.
11. Eysenbach G. What is e-health? *J Med Internet Res.* 2001;3(2):e20.
12. Portnoy DB, Scott-Sheldon L, Johnson BT, Carey MP. Computer-delivered interventions for health promotion and behavioral risk reduction: A meta-analysis of 75 randomized controlled trials, 1988-2007. *Prev Med.* 2008;47:3-16.
13. Norman GJ, Zabinski MF, Adams MA, Rosenberg DE, Yaroch AL, Atienza AA. A Review of eHealth Interventions for Physical Activity and Dietary Behavior Change. *Am J Prev Med.* 2007;33(4):336-345.
14. Broekhuizen K, Kroeze W, van Poppel M, Oeneme A, Brug J. A Systematic Review of Randomized Controlled Trials on the Effectiveness of Computer-Tailored Physical Activity and Dietary Behavior Promotion Programs: an Update. *Ann Behav Med.* 2012;44:259-286.

15. Bensley RJ, Anderson JV, Brusk JJ, Mercer N, Rivas J. Impact of Internet vs Traditional Special Supplemental Nutrition Program for Women, Infants, and Children Nutrition Education on Fruit and Vegetable Intake. *J Am Diet Assoc*. 2010;11:1723-1727.
16. Pedersen S, Grønhøj A, Thøgersen J. Texting your way to healthier eating? Effects of participating in a feedback intervention using text messaging on adolescents' fruit and vegetable intake. *Health Educ Res*. 2016:31(2):171-84.
17. Bandura A. Social cognitive theory: An agentic perspective. *Asian J Soc Psychol*. 1999;2:21 41.
18. Anderson M. Technology Device Ownership: 2015. Pew Research Center. 2015. http://www.pewinternet.org/2015/10/29/technology-device-ownership-2015. Accessed April 13, 2016.
19. Smith A. U.S. Smartphone Use in 2015. Pew Research Center. 2015. http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/Pew Internet & American Life Project. Accessed April 13, 2016.
20. Duggan M. Mobile Messaging and Social Media 2015. Pew Research Center. 2015. http://www.pewinternet.org/2015/08/19/mobile-messaging-and-social-media-2015/. Accessed April 13, 2016.
21. Smith A. Americans and text messaging. Pew Research Center. 2011. http://www.pewinternet.org/2011/09/19/americans-and-text-messaging/. Accessed June 29, 2016.

APPENDIX A

University of Alaska Fairbanks Institutional Review Board Approval Letter for Chapter 2

UNIVERSITY OF ALASKA FAIRBANKS

(907) 474-7800
(907) 474-5444 fax
uaf-irb@alaska.edu
www.uaf.edu/irb

Institutional Review Board

909 N Koyukuk Dr. Suite 212, P.O. Box 757270, Fairbanks, Alaska 99775-7270

September 11, 2014

To:	Andrea Bersamin Principal Investigator
From:	University of Alaska Fairbanks IRB
Re:	[610787-3] Using mobile phone short message service (SMS; text messaging) to promote fruit and vegetable consumption among WIC recipients, a pilot study

Thank you for submitting the Amendment/Modification referenced below. The submission was handled by Expedited Review under the requirements of 45 CFR 46.110, which identifies the categories of research eligible for expedited review.

Title:	Using mobile phone short message service (SMS; text messaging) to promote fruit and vegetable consumption among WIC recipients, a pilot study
Received:	September 9, 2014
Expedited Category:	7
Action:	APPROVED
Effective Date:	September 11, 2014
Expiration Date:	May 22, 2015

This action is included on the October 1, 2014 IRB Agenda.

No changes may be made to this project without the prior review and approval of the IRB. This includes, but is not limited to, changes in research scope, research tools, consent documents, personnel, or record storage location.

APPENDIX B

University of Alaska Fairbanks Institutional Review Board Exemption Letter for Chapter 3

UNIVERSITY OF ALASKA FAIRBANKS

(907) 474-7800
(907) 474-5444 fax
uaf-irb@alaska.edu
www.uaf.edu/irb

Institutional Review Board

909 N Koyukuk Dr. Suite 212, P.O. Box 757270, Fairbanks, Alaska 99775-7270

October 30, 2015

To:	Andrea Bersamin Principal Investigator
From:	University of Alaska Fairbanks IRB
Re:	[827865-1] Promoting vegetables and fruit in the YK Delta PART 2

Thank you for submitting the New Project referenced below. The submission was handled by Exempt Review. The Office of Research Integrity has determined that the proposed research qualifies for exemption from the requirements of 45 CFR 46. This exemption does not waive the researchers' responsibility to adhere to basic ethical principles for the responsible conduct of research and discipline specific professional standards.

Title:	Promoting vegetables and fruit in the YK Delta PART 2
Received:	October 29, 2015
Exemption Category:	*[2*
Effective Date:	October 30, 2015

This action is included on the November 4, 2015 IRB Agenda.

Prior to making substantive changes to the scope of research, research tools, or personnel involved on the project, please contact the Office of Research Integrity to determine whether or not additional review is required. Additional review is not required for small editorial changes to improve the clarity or readability of the research tools or other documents.

APPENDIX C

Yukon-Kuskokwim Health Corporation Approval Letter for Chapter 3

YUKON-KUSKOKWIM HEALTH CORPORATION
"Working Together to Achieve Excellent Health"

October 19, 2015

Andrea Bersamin
Center for Alaska Native Health Research
PO Box 757000
Fairbanks, AK 99775-7000
abersamin@alaska.edu

Dear **Andrea**:

This letter is to inform you on **10/13/15**; the Yukon Kuskokwim Health Corporation's Executive Board of Directors approved your **Current Technology Use Survey and 10 women cognitive structured interview** modifications for the study **15.06.05 Promoting vegetable and fruit intake among Yup'ik families with young children**. For YKHC tracking purposes, please label all future correspondence regarding this study with this assigned YKHC # (**15.06.05**).

Remember that all publications/presentations of data derived from the results of this study require formal approval by the YKHC Board prior to presentation/publication (this includes thesis defense for graduate studies).

As a note since you are involved in many research projects here on the YK Delta, when submitting manuscripts/abstract for approval, please provide:

1. An electronic copy of the full manuscript (email to joe_klejka@ykhc.org)
2. Complete the YKHC manuscript info sheet and submit electronically as well.
3. Provide designated fee to offset costs incurred by YKHC in review process

To assist in timely approval, please plan on providing YKHC at least a two-month window to review and approve any such manuscripts. The YKHC Executive Board meets every other month and depending on time of submission, approval could take even longer since time must be allowed for the YKHC Human Studies Committee to review the manuscript and then recommend it to the YKHC Board for approval. For best results we would suggest beginning communications with my office as early as possible to help coordinate timing of submittal for review so as to assist in a quick approval process.

YKHC supports the work you are doing in increasing the knowledge of best health practices for our population through your research. YKHC sincerely appreciates your work, enthusiasm, and effort, and looks forward to your continued success.

P.O. Box 528 • Bethel, Alaska 99559 • 907-543-6000 • 1-800-478-3321

APPENDIX D

Yukon-Kuskokwim Health Corporation Approval Letter for Chapter 3 Publication

YUKON-KUSKOKWIM HEALTH CORPORATION
"Working Together to Achieve Excellent Health"

6/22/16

Andrea Bersamin
Center for Alaska Native Health Research
PO Box 757000
Fairbanks, AK 99775-7000
abersamin@alaska.edu

Dear **Andrea**:

This letter is to inform you on **June 21, 2016**, the Yukon Kuskokwim Health Corporation's Executive Board of Directors approved the manuscript **16.05.04 Exploring the Potential for Technology-Based Nutrition Education for WIC Recipients in Alaska Native Communities** for publication. For YKHC tracking purposes, please label all future correspondence with the assigned YKHC # (**16.05.04**).

Remember that all publications/presentations of data derived from the results of this study require formal approval by the YKHC Board prior to presentation/publication (this includes thesis defense for graduate studies).

As a note since you are involved in many research projects here on the YK Delta, when submitting manuscripts/abstract for approval, please provide:

1. An electronic copy of the full manuscript (email to joe_klejka@ykhc.org)
2. Complete the YKHC manuscript info sheet and submit electronically as well.
3. Provide designated fee to offset costs incurred by YKHC in review process.

To assist in timely approval, please plan on providing YKHC at least a two-month window to review and approve any such manuscripts. The YKHC Executive Board meets every other month and depending on time of submission, approval could take even longer since time must be allowed for the YKHC Human Studies Committee to review the manuscript and then recommend it to the YKHC Board for approval. For best results we would suggest beginning communications with